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DECLINING PERFORMANCE OF TANK IRRIGATION SYSTEM IN SRIKAKULAM DISTRICT, ANDHRA PRADESH – A STUDY WITH IRRIGATION INDICIES

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ABSTRACT

Historically, tanks formed the primary sources of minor irrigation in the country as a whole and South India in particular, in conformity with local conditions. However, in the recent past, the minor irrigation under tanks received a setback due to various reasons. The Srikakulam district located in the north coastal Andhra Pradesh depending largely on minor irrigation under tanks is no exception. In certain mandals of this district, the problem is so severe and thus, it became a matter of concern for the researchers and the government to study and evaluate the problem in order to take remedial measures. Keeping this in view, an attempt is made in this present work to conduct a study on minor irrigation under tanks in Srikakulam district, using the data obtained on various factors over a period of six decades. The data so collected is synthesized and the following irrigation indices viz., 1) Ratios of irrigated and cropped areas i.e.net, gross, and irrigated more than once 2) Irrigation intensities 3) Crop intensities 4) Tank Effective Ratios (TER) 5) Tank Deviation Factors (TDF) are evaluated. From these indices, it is observed that there is a considerable reduction in the capacities of the tanks of Srikakulam district during the study period of 1955 to 2010 indicating that the minor irrigation under tanks in the district suffered with negative growth rates.

KEYWORDS: Irrigation Indicies, Tank Effective Ratio, Tank Deviation Factor, Minor Irrigation

INTRODUCTION

In Southern states of semi-arid and tropical parts of India, tank irrigation systems have existed since vedic times (Yazdani. G [6], 1960). In Southern India, the monsoon rains fall erratically during a few months in a year and thus, necessitating for the storage of the run-off and regulation of the flow of water for further agricultural usage. Thus, the tank irrigation system became an established practice in Southern India (Von Oppen. M [5] et al.1960). The potential of the tank irrigation system not only depends on availability of water but also on the rainfall during the early crop seasons in the semiarid regions like that of Southern-India. Therefore, a mathematical modeling is necessary and to determine the optimal cropping pattern under the influence of various irrigation indices (Mayya S.G. and Ram Prasad [3], 1989). Various studies conducted on minor irrigation under tanks in both Visakhapatnam and Vizianagaram districts of Andhra Pradesh, observed that there was a substantial decrease in the irrigation under tanks to a tune of 20% to 30% during 1955-56 to 1986-87. Tank Effective Ratios (TER) and Deviation Factors (DF) obtained in these studies have shown that most of the tanks are underutilized (Rao J M [1,2] et al. 1990). In Srikakulam district where tank irrigation accounted for 54.23 percent of the total irrigated area in 1955-56, has declined to 28.14 by 1986-87 (Saradhi G P [4], 1993). These studies show a declining trend in the areas under tank irrigation throughout the state and Srikakulam district is no exception. In line with these observations, Srikakulam district is selected for a detailed study on its potential for tank irrigation system in this present work.

METHODOLOGY

Study Area

Srikakulam district is the northern most coastal districts of Andhra Pradesh with three types of physiographic areas viz., coastal planes, interior planes and upland and hilly areas. The district experiences tropical monsoon type of climate with four distinct seasons. The average annual rainfall of the district is 1161.53mm with 70% to 80% of which occurring during South-West monsoon season i.e. June to September. Minor irrigation in Srikakulam district accounts for nearly 60% of the total irrigation in the district with an irrigated area of 2, 11, 497 hectares as per government records for the year 2010. The district has a total of7, 721 tanks out of which 7,472 are Panchayat Raj (PR) tanks and the remaining 249 are administered by PWD. Specific reference of irrigation in Rajam mandal of the district is incorporated in the present work, since 95% of the irrigated area in Rajam mandal is under tank irrigation system only. Rajam mandal is located in interior planes of Srikakulam district with a geographical area of 128.50 square kilometers, and possesses 332 tanks of which, 316 are PR tanks and the remaining are PWD tanks.

Irrigation Indices

In order to conduct research studies on various aspects of minor irrigation under tanks, a number of irrigation indices like Tank Effective Ratio (TER), Tank Deviation Factor (TDF), Irrigation intensity, Crop intensity etc. are to be studied. A brief account of all these indices is as follows.

Tank Effective Ratio (TER)

It indicates the ayacut area irrigated by 1 unit (1 hectare) of the tank area and reflects the effectiveness of the tank with reference to its irrigation potential. The higher value of TER indicates that, the capacity of the tank is more either in terms of depth or water spread area. The lower value of TER of a particular tank over a period indicates the gradual decrease of the capacity of the tank due to varied reasons like siltation, reduction in tank bed area etc.

Tank Deviation Factor (TDF)

Tank Deviation factor is the ratio of the difference between actual and registered ayacuts and the registered ayacut. The positive TDF indicates that, the tank is irrigating more ayacut than the registered, on other hand, the negative TDF indicates the under utilization of the tank. The TDF along with the TER gives an insight on the performance of the tanks and form a basis for the critical evaluation of the minor irrigation under tanks in a specified area.

Irrigation Intensity

Irrigation intensity is the ratio of gross irrigated area to the net irrigated area. The higher values of irrigation intensity indicate the existence of large scale areas irrigated more than once in the specified study area. The values nearer to one indicate that, the net and gross areas are more or less equal and there are no second crops raised during the specified agricultural year in the study area.

Crop Intensity

Crop intensity is the ratio of gross cropped area to the net area sown. Similar to that of irrigation intensity the values of crop intensity nearer to one indicate that, no second crops are being raised in the specified area under study.

Calculation of Irrigation Indices

The details of the irrigated areas under tank irrigation systems for various mandals of Srikakulam district are obtained for the period 1955 to 2010 from the Directorate of Economics and Statistics, Government of Andhra Pradesh, Hyderabad and are used for the calculation of the following irrigation indices.

- **Ratio of GAI/GCA**

  Where: GAI= Gross Area Irrigated

  GCA=Gross Cropped Area

- **Ratio of NAI/NSA**

  Where: NAI =Net Area Irrigated

  NSA= Net Sown Area

- **Ratio of AIMO / NAI**

  Where: AIMO= Area Irrigated More than Once

  NAI = Net Area Irrigated

- **Irrigation Intensity = GAI / NAI.**
- **Crop Intensity = GCA / NSA.**

Study on Tank Performance

The capacity of various tanks, their catchment areas and the registered and actual ayacut areas under various tanks in the study area are obtained from O/o Executive Engineer, I& CAD, Irrigation division, Srikakulam. The Data is used for the calculation of the following factors which help in studying the performance of irrigation under tanks in the study area.

Tank Effective Ratio (TER) $= \frac{\text{Area irrigated by the tank}}{\text{Area of the tank}}$

Tank Deviation Factor (TDF) $= \frac{\text{Actual present ayacut-Registered ayacut}}{\text{Registered ayacut}} \times 100$

RESULTS AND DISCUSSIONS

The irrigation indices are evaluated from the data obtained from various sources as mentioned above and the results are tabulated in the following tables, 1 to 5.

Table 1: Irrigation Indices, Srikakulam District, A. P

Duration	Irrigation Indices					
	NAI/ NSA	GAI/ GCA	AIMO/ ASMO	AIMO/ NAI	Irrigation Intensity (%)	Crop Intensity (%)
1955-60	0.53	0.48	0.31	16.35	116.00	129.00
1960-65	0.56	0.48	0.19	10.59	111.00	128.00
1965-70	0.51	0.46	0.22	8.25	108.00	119.00
1970-75	0.48	0.45	0.26	9.08	109.00	117.00
1975-80	0.50	0.45	0.23	8.64	109.00	118.00
1980-85	0.57	0.50	0.19	6.82	107.00	120.00

Table 1: Contd.,

1985-90	0.54	0.46	0.13	7.64	106.00	123.00
1990-95	0.58	0.47	0.10	7.89	108.00	136.00
1995-2K	0.57	0.45	0.11	6.78	107.00	135.98
2000-05	0.58	0.46	0.11	6.38	106.00	134.00
2005-10	0.53	0.47	0.18	11.76	127.00	139.00
Average	0.54	0.47	0.19	9.11	110.36	124.82

Table 2: Tank Performance Indicators of PR Tanks, Srikakulam District

Sl. No.	Mandal	No. of PR Tanks	TER	TDF
1	Veeraghattam	142	1.89	-25.48
2	Vangara	207	4.59	-15.99
3	R.amadalavalasa	488	1.81	-22.17
4	Rajam	316	1.84	-23.01
5	Santhakaviti	235	1.64	-24.94
6	Palakonda	98	2.39	-27.13
7	Seethampeta	38	4.14	-28.37
8	Bhamini	41	3.91	-29.16
9	Kothuru	133	3.24	-49.68
10	Hiramandalam	84	3.17	-15.22
11	Saravakota	442	3.46	-33.69
12	Pathapatnam	279	3.18	-30.44
13	Meilaputti	196	3.72	-24.03
14	G. Sigadam	356	1.95	-17.29
15	Laveru	298	1.57	-27.87
16	Ranastalam	323	2.01	-15.69
17	Etcherla	135	1.61	-22.03
18	Ponduru	198	1.37	-31.89
19	Burja	147	1.98	-27.46
20	Sarabujjili	143	2.21	-24.30
21	Amadalavalasa	180	2.18	-19.34
22	Srikakulam	227	1.76	-24.29
23	Gara	154	2.39	-24.24
24	Polaki	235	1.68	-26.64
25	Narasannapeta	120	2.22	-12.13
26	L.NPeta	46	1.95	-15.87
27	Jalumuru	287	2.69	-13.75
28	Tekkali	189	2.19	-33.06
29	Kotabommili	346	2.18	-25.94
30	Santhabommali	277	1.60	-25.11
31	Nandigam	291	1.60	-21.13
32	Vajrapukothuru	101	1.65	-23.77
33	Palasa	393	2.39	-15.09
34	Mandasa	54	2.49	-26.45
35	Sompeta	82	1.52	-19.71
36	Kanchili	114	2.02	-26.35
37	Kaviti	32	2.60	-27.50
38	Itchapuram	45	1.68	-28.70
		Total: 7472	**Average: 2.33**	**Average: -24.34**

Table 3: Tank Performance Indicators of PWD Tanks, Srikakulam District

Sl. No.	Mandal	No. of PWD Tanks	TER	TDF
1	Veeraghattam	0	0.00	0.00
2	Vangara	3	2.35	-21.91
3	Regidi	15	3.50	-18.55

	Amadalavalasa			
4	Rajam	16	3.31	-31.56
5	Santha kaviti	15	2.19	-23.36
6	Palakonda	0	0.00	0.00
7	Seethampeta	0	0.00	0.00
8	Bhamini	0	0.00	0.00
9	Kotturu	10	1.92	-37.39
10	Hiramandalam	7	3.05	-16.59
11	Saravakota	10	2.34	-17.33
12	Pathapatnam	8	3.59	-24.28
13	Meliaputti	6	3.81	-18.34
14	G.Sigadam	25	2.92	-20.51
15	Laveru	10	2.59	-25.52
16	Ranastalam	7	2.67	-26.58
17	Etcherla	0	0.00	0.00
18	Ponduru	3	2.37	-23.88
19	Burja	7	3.28	-20.39
20	Sarubujjili	14	3.04	-15.61
21	Amadala valasa	3	2.73	-25.81
22	Srikakulam	7	2.09	-15.87
23	Gara	4	3.07	-15.61
24	Polaki	0	0.00	0.00
25	Narsannapeta	0	0.00	0.00
26	L.N.Peta	14	3.46	-20.06
27	Jalumuru	5	3.19	-17.43
28	Tekkali	3	2.65	-20.55
29	Kotabommali	5	3.51	-18.40
30	Santhabommali	0	0.00	0.00
31	Nandigam	10	2.77	-18.86
32	Vajrapu kotturu	2	2.78	-19.21
33	Palasa	8	3.51	-24.90
34	Mandasa	0	0.00	0.00
35	Sompeta	24	3.16	-28.90
36	Kanchili	0	0.00	0.00
37	Kaviti	5	2.65	-25.03
38	Itchapuram	3	0.44	-6.93
		Total: 249	**Average: 2.81**	**Average: -28.54**

Table 4: Tank Performance Indicators of PR Tanks, Rajam Mandal, Srikakulam District

Sl. No.	Name of the Village	No of Tanks	TER	TDF
1	Dosari	3	0.43	-23.60
2	Vommi	18	1.86	-23.60
3	Gandimudidam	17	1.85	-23.60
4	DRN Valasa	6	2.01	-17.35
5	Aguru	13	1.78	-25.34
6	Kancharam	11	1.86	-23.60
7	Pogiri	18	2.33	-4.33
8	Saradhi	5	1.86	-23.60
9	Kondapeta	8	1.86	-23.60
10	Guravam	11	1.86	-23.60
11	Rajam	6	1.86	-23.60
12	Gopalapuram	9	1.86	-23.60
13	Rajayyapeta	18	1.86	-23.60
14	VR Agraharam	7	1.86	-23.60
15	Soperu	10	1.86	-23.60
16	Maredubaka	8	1.86	-23.60

Table 4: Contd.,

17	Antakapalli	6	1.86	-23.60
18	Boddam	17	1.86	-23.60
19	Viziarampuram	9	1.86	-23.60
20	Ramanujalapeta	8	1.86	-23.60
21	Nandabalaga	8	1.86	-23.60
22	Kotarepuram	7	1.86	-23.60
23	Syampuram	9	1.86	-23.60
24	GCH palli	14	1.86	-23.60
25	BMN Valasa	11	1.86	-23.60
26	MJ valasa	14	1.86	-23.60
27	Antakapalli	5	1.86	-23.60
28	Kottavalasa	6	1.86	-23.60
29	Ampolu	4	0.38	-23.60
30	Guyyannavalasa	11	1.86	-23.60
31	Penubaka	9	1.86	-23.60
32	Amaram	3	0.30	-71.35
33	Kothapeta	4	0.67	-68.52
34	Boddavalasa	3	0.46	-67.74
		Total: 316	**Average: 1.84**	**Average: -23.01**

Table 5: Tank Performance Indicators of PWD Tanks, Rajam Mandal, Srikakulam District

Sl. No	Name of the Village	Name of the Tank	TER	TDF
1	Amaram	Darmarayuni tank	2.91	-27.72
2	Kothapeta	Peddatimmaji poonu system	1.92	-31.81
3	Aguru	Chuttu tank	3.27	-27.55
4	Kancharam	Bhaganna tank	3.23	-33.64
5	Rajam	Veeraju tank	3.79	-33.25
6	Saradi	Timmayya tank	4.09	-30.40
7	Penubaka	Patnaikuni tank	4.41	-35.18
8	Maredubaka	Mallamma tank	2.68	-26.69
9	Kothavalasa	Pothayya tank	4.12	-34.20
10	Maredubaka	Pothivani tank	4.75	-31.07
11	Vijayaramapuram	Gopinaidu	4.08	-38.64
12	Syampuram	Vallabadasu tank	3.75	-31.39
13	Soperu	Nalla tank	3.31	-31.08
14	Nandabalaga	Baddi tank	4.29	-30.16
15	V.R.Agrahram	Raju tank	2.24	-31.17
16	Boddavalasa	Meduri krishnamma tank	3.82	-33.27
Average			**3.54**	**-31.70**

It is observed from the Table 1 that, the net area irrigated compared to net sown area is almost constant for the district during the period 1955-56 to 2005-10. Same is the case with the gross areas irrigated compared with that of gross cropped areas. It is further observed that the irrigation intensity computed for the five year periods got decreased steadily up to 2000-05 in Srikakulam district. However, there is a large scale increase of irrigation intensity for the period 2005-10 which is due to the implementation of tank renovation programmes taken up on large scale throughout the state and the Srikakulam district.

From the tables 2 and 3, it is observed that, the capacities of the tanks in Srikakulam district got reduced considerably compared to their designed capacities. The negative values for the tank deviation factors of all the tanks cited in the above mentioned tables confirm this. The PR tanks totaling to 7472, experienced a reduction of 24.34% on an average in their capacities, in other words they are underutilized by 24.34% when compared with their original capacities.

The tanks in Kotturu mandal had an alarming deviation factor -49.68% which shows that the capacities of these tanks in this mandal got reduced by 50% compared to the good olden days. The capacities of 249 PWD tanks also reduced by an average value of 28.54%in the district and by 37.39% in Kotturu mandal.

From the tables 4 and 5, it can be observed that the 316 PR tanks of Rajam mandal had a reduction in their capacities by 23.01% on an average. The tanks in villages viz., Amaram, Kothapeta and Boddavalsa had shown a reduction of 70% in their capacities. The 16 PWD tanks in Rajam mandal also had an average reduction of 31.70 in their capacities.

CONCLUSIONS

- The irrigation indices evaluated for the period 1955 to 2010 for Srikakulam district show that the net area irrigated compared to the net sown area is almost constant in the district. Similarly, the gross areas irrigated compared with that of the gross cropped areas are also observed to follow the similar trend.
- The irrigation intensity decreased steadily during the study period up to 2005 in Srikakulam district. However, from 2005 to 2010 the district experienced an increase in the irrigation intensity, which is due to the implementation of tank renovation programmes taken up on large scale throughout the State by the Government of Andhra Pradesh, recently.
- The study on the tank performance indicators of various tanks in Srikakulam district shows that the 7,472 PR tanks of the district registered a reduction of 24.34% on an average in their capacities i.e. these tanks are underutilized by 1/4th of their original capacities. Similarly, the 249 PWD tanks of the district registered 28.54% reduction in their original capacities.
- The study conducted on the capacities of PR and PWD tanks of Rajam mandal has shown a reduction in their capacities by 23.01% and 31.70% respectively. The tanks in certain villages of Rajam mandal like Amaram, Kothapeta and Bodduvalasa has shown an alarming rate of reduction in their capacities to a tune of 70%.
- From the above cited figures, it is concluded that there is a considerable reduction in the designed capacities of the tanks in Srikakulam district during the study period of 1955 to 2010. This can be attributed to the shrinkage of tank bed area due to various factors like encroachments, growth of weeds, siltation of the tanks and the feeder channels, improper maintenance of sluices and tank structures etc.

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